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Los Alamos
National Laboratory

Risk Reduction and Environmental Stewardship Division

Ecology Group
(RRES-ECO)

Quality Assurance Project Plan

for the

Soil, Foodstuffs, and Biota Monitoring Project

Prepared by: Phil Fresquez, Contaminant Monitoring Team	Date:
Prepared by: John Nyhan, Contaminant Monitoring Team	Date:
Concurred by: Phil Fresquez, Contaminant Monitoring Team Leader	Date:
Approved by: Doug Stavert, Risk Reduction and Environmental Stewardship-Environmental Protection	Date:

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Appendixes

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History of revision

The following table lists the revisions, dates, and changes to this document.

Revision	Date	Description of Changes
0	9/30/02	New Document

Plan format

This quality assurance project plan (QAPP) uses the format recommended in Department of Energy (DOE) Order 414.1A (DOE 1998), but elements of the data quality objective process from the Environmental Protection Agency (EPA) QA/R-5 document (EPA 1994a) are also included. The document is tiered with respect to the Ecology Group (RRES-ECO) Quality Management Plan (QMP) (RRES-ECO 2002) and the Soil, Foodstuffs, and Biota Monitoring Project's implementing procedures. Taken together, these documents formally describe the project's mission, organizational structure, roles and responsibilities, work processes, and the way quality is assured.

This plan has been designed to ensure quality assurance aspects for the ongoing monitoring of soil, foodstuffs, and biota as part of the Environmental Surveillance Program at Los Alamos National Laboratory (LANL) mandated by DOE Orders 5400.1 (DOE 1990a) and 5400.5 (DOE 1990b). Drivers for the quality plan include

DOE O 414.1A, "Quality Assurance" (DOE 1998),

Risk Reduction and Environmental Stewardship (RRES) Division Quality Management Plan (To Be Written), and

RRES-EPP-IMP, "Integrated Management Plan for the Environmental Protection Programs" (Stavert 2002).

The DOE and LANL require compliance with DOE Order 414.1A for all organizations. This plan is structured to address the 10 criteria of the Order, and each section explains the Group's requirements for compliance with the corresponding criterion.

General Information, continued

Revising and distributing this plan

The Group Leader and a chosen reviewer will approve all revisions to this plan.

This QAPP is a controlled document. It is reviewed annually and revised if necessary, and it is distributed in accordance with the RRES-ECO document control program (RRES-ECO-030, "Document Distribution," To Be Written).

Section 1
Project Description

Requirements

Regulatory drivers

This QAPP describes how soil, foodstuffs, and biota monitoring is conducted at LANL by RRES-ECO. It has been designed to ensure quality assurance aspects of the ongoing contaminant monitoring project. The drivers for the development and implementation of this monitoring project are presented in Tables 1 and 2. These drivers are grouped by applicable performance requirements from Laboratory Performance Requirement (LPR) 404-00-00.2 (LANL 2002a) and other performance requirements and drivers.

In addition to all of these regulatory drivers, all teams are required to comply with DOE Order 414.1A (DOE 1998), which supersedes DOE Order 5700.6C (DOE 1991a), as well as DOE Order 151.1 (DOE 1995a). DOE Order 151.1 provides the framework for development, coordination, control, and direction of all emergency planning, preparedness, readiness assurance, response, and recovery for the DOE Emergency Management System.

Other drivers

Other drivers for RRES-ECO include

- University of California (UC) commitment measures (Appendix F of the UC/DOE contract) for outstanding relations with stakeholders and neighbors in northern New Mexico (LANL 2001a),
- RRES-ECO commitment to improve service delivery and customer satisfaction,
- responding to requests for technical assistance in meeting surrounding community needs for environmental monitoring and information,
- addressing general community concerns related to ecological and environmental issues, and
- providing tools to line management for implementation of Integrated Safety Management and Integrated Safeguards and Security Management principles.

Table 1. Performance Requirements and Drivers from LPR 404-00-00.2 (LANL 2002a) for the Soil, Foodstuffs, and Biota Monitoring Project.

Title	Law	Regulation	DOE Implementing Requirements	Special comment*
DOE General Environmental Protection Program Requirements (1990)	42 U.S.C. Sect. 2011, Sect. 2259		DOE O 5400.1 (DOE 1990a)	Authorized under Atomic Energy Act
DOE Radiation Protection of the Public and the Environment (1993)			10 CFR Part 834 (DOE 1991b)	Authorized under Atomic Energy Act
DOE Radiation Protection of the Public and the Environment (1995)			DOE O 5400.5 (DOE 1990b)	Authorized under Atomic Energy Act
Environmental Surveillance Reporting Requirements (1996)			DOE O 231.1 (DOE 1995b)	Authorized under Atomic Energy Act
National Fire Protection Association (NFPA) Codes and Standards (2000)		NFPA 295, 299, 801, 909, and 914	DOE O 5480.7A (DOE 1992)	Implementation via SWEIS MAP Wildfire Hazard Reduction Project
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Natural Resources Damages Assessment (NRDA) - Section 120 (1993)	42 U.S.C. 9601 et seq. EO 12580	40 CFR Part 300 43 CFR Part 11, Sections 107 and 120	DOE O 5400.4 (DOE 1989)	NRDA provision of CERCLA
Oil Pollution Act (1990)	33 U.S.C. 2701 *et seq.* EO 12580		DOE O 5400.4 (DOE 1989)	
Greening the Government through Leadership in Environmental Management (1998)	EO 13101		DOE Notice 450.5 (DOE 2001)	Expected to be implemented under new Order that replaces DOE O 5400.1
Land and Facility Use Planning (1996)			DOE P 430.1 (DOE 1996)	Implementation via SWEIS MAP Integrated Resources Management Plan and Comprehensive Site Plan

* SWEIS MAP = Site-Wide Environmental Impact Statement Mitigation Action Plan

Table 2. Other Performance Requirements and Drivers for Soil, Foodstuffs, and Biota Monitoring Project.

Title	Reference
Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance	DOE/EH-0173T (DOE 1991c)
New Mexico Environment Department DOE Oversight Bureau Agreement in Principle	http://www.nmenv.state.nm.us/DOE_Oversight/doetop.html

Objectives

Project purpose

LANL's ongoing Environmental Surveillance Program is required by Department of Energy (DOE) Orders 5400.1 (DOE 1990a) and proposed 10 CFR 834 (DOE 1991b). Sampling and analysis of soil, foodstuffs, and biota are performed on an annual basis in an effort to monitor LANL operations for release of potential radioactive, heavy metal, and organic contaminants in the human food chain. Some of the objectives of the Soil, Foodstuffs, and Biota Monitoring Project are to

- determine the concentrations of radionuclides, heavy metals, and organic contaminants in soil, foodstuffs, and biota collected from onsite, perimeter, and regional (background) areas;
- determine if there is any measurable long-term buildup in the surrounding environment;
- establish baselines of environmental quality for Laboratory site-specific radionuclides, heavy metals, and organic contaminants from selected regional soil, foodstuffs, and biota;
- estimate public radiation doses related to the consumption of selected soil, foodstuffs, and biota;
- verify compliance with the Effective Dose Equivalents (EDEs) in DOE Order 5400.5 (DOE 1990b) and DOE Standard 1153-2002 (DOE 2002);
- characterize and define trends, if any, of radionuclides, heavy metals, and organic contaminants in selected soil, foodstuffs, and biota; and
- publish the results of all soil, foodstuffs, and biota monitoring activities in the Laboratory annual Environmental Surveillance Report (LANL 2001b) and other scientific forums.

Objectives, continued

Description of project site terrain and contaminant transport parameters

At the outset, the importance of the site's complex terrain and its influence on most ecological and environmental variables must be recognized. Wind and water erosion variables for soils, for example, are particularly sensitive to terrain features. Soil provides an integrating medium that can account for contaminants released to the atmosphere, either directly in gaseous effluents or indirectly from resuspension of onsite contamination, or through liquid effluents released to a stream that is subsequently used for irrigation.

The 400-m difference in elevation across the LANL site produces significant precipitation differences, resulting in variation in the terrestrial biotic and soil components of the ecosytems, farms, and gardens occurring along this elevation gradient. In terms of aquatic ecosytems, there are 19 canyons that traverse LANL lands to the Rio Grande, all of which contain intermittent steams and many of which contain wetlands.

In terms of the distribution of contaminants, radionuclides, heavy metals, and organic contaminants present in the water will be present in aquatic organisms, and most, but not all, contaminants detectable in water will be present at detectable concentrations in the organism. The principal pathways by which foods become contaminated are deposition from airborne materials and crop irrigation from surface or ground waters.

It must also be recognized that variables affecting the distribution of radionuclides, heavy metals, and organic contaminants display a lot of temporal variability, and that variability occurs over many different time scales. Therefore, the monitoring program at the Los Alamos site reflects the differing spatial and temporal sampling requirements of those applications.

Organization

Project organization

RRES-ECO is organized by project teams under the line-management direction and responsibility of the Group Leader. See the RRES-ECO QMP (RRES-ECO 2002) for the group organizational structure. The Contaminant Monitoring Team Leader is responsible for this monitoring effort.

Other Laboratory organizations and subcontractors will be utilized, as necessary, to facilitate the performance of monitoring activities in accordance with this plan.

Structure of the quality program

This QAPP, including implementing procedures, is a second-tier document to the RRES-ECO QMP (RRES-ECO 2002). The following documents provide requirements to ensure the project is operated in accordance with the above regulatory drivers:

- RRES-ECO QMP (RRES-ECO 2002).
- RRES-ECO Soil, Foodstuffs, and Biota Monitoring Project QAPP (this document)
- Implementing procedures (Standard Operating Procedures).

Implementation

The following table lists specific responsibilities.

Who	What
Contaminant Monitoring Team Leader	Ensure that monitoring is performed in accordance with the requirements specified in this plan.

Section 2
Personnel Development

Personnel Training and Qualification

Personnel requirements

Qualified team members will be hired and trained as prescribed in the RRES-ECO QMP (RRES-ECO 2002).

Personnel are required to have knowledge of the following:

- Environmental Soil and Plant Science/Radioecology
- Pathway Analysis
- Environmental Monitoring
- Sample collection, processing, and chain-of-custody
- Statistics

Training

All personnel performing project-related work are required to obtain appropriate training before performing work governed by a procedure. Training for RRES-ECO personnel, and for other persons performing RRES-ECO work, will be performed and documented according to RRES-ECO-024, "Personnel Training." (To be Written). Training of personnel in other groups will be performed and documented according to each group's training procedure.

Contractor analytical laboratories are required to have training and training documentation systems in place that comply with the training requirements of DOE Order 414.1, Criterion 2 (DOE 1998).

Section 3
Quality Improvement

Performance reports	Personnel assigned to perform contaminant monitoring activities provide periodic updates, either verbal or written, to the Contaminant Monitoring Team Leader. The Team Leader provides periodic updates, either verbal or written, to the RRES-ECO Group Leader.
Corrective actions within RRES-ECO	Corrective actions for all RRES-ECO projects are initiated, tracked, corrected, and documented according to the RRES-ECO QMP (RRES-ECO 2002) and Group procedure RRES-ECO-026, "Deficiency Tracking and Reporting" (To be Written).
Quality improvement	Contaminant monitoring activities will adhere to the policy for continuous improvement as given in the RRES-ECO QMP (RRES-ECO 2002).

Section 4
Documents, Records, and Electronic Media

Documents and Records

Policy

The Soil, Foodstuffs, and Biota Monitoring Project will generate and retain sufficient records to ensure compliance with the monitoring requirements of DOE Orders 5400.1 and 5400.5. Specific guidelines for soil, foodstuffs, and biota monitoring can be found in the Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE 1991c). The type and extent of records to be maintained are determined through this plan and its implementing procedures.

Additionally, data that are maintained in electronic form (e.g., databases and spreadsheets) will be maintained in a manner that ensures defensibility and accuracy.

Document control

This plan is controlled through the RRES-ECO document control procedure. The following personnel will receive controlled copies of this plan:

- RRES Environmental Protection Program Manager,
- RRES-ECO Group Leader,
- Contaminant Monitoring Team Leader,
- LANL personnel assigned to work for the Soil, foodstuffs, and biota monitoring Project,
- RRES-ECO Quality Assurance Officer, and
- Assistant Area Manager, Office of Environment and Projects, DOE Los Alamos Site Office.

Procedures

Procedures will be developed (see Appendix B) as necessary and in accordance with the policy in the RRES-ECO QMP (RRES-ECO 2002).

Disposition and retention

Active files are maintained and kept by assigned project personnel. After files have been finalized and all documentation is complete, these files are submitted as records to the records coordinator. Records are archived in compliance with Laboratory and DOE requirements for records retention, storage, and management.

Electronic Media

Policy

The Soil, Foodstuffs, and Biota Monitoring Project will utilize electronic means as necessary to maintain data and perform calculations on these data. Electronic means will not replace paper copy. All records that must be maintained to meet the requirements of the Orders will be kept in hard copy as the official record.

Databases

Backups -- All databases used to hold data and generate reports to be used in demonstrating compliance will be maintained on a common drive of a server. These databases will be backed up daily to minimize potential losses of data.

Verification of data -- All compliance-related data uploaded into a database will be verified to be accurate against the original paper copy. Data that are uploaded through electronic means will undergo 10% verification. Data that are uploaded through manual means will undergo 100% verification. The 100% review must be performed by someone other than the data entry person. This review will be documented and forwarded to the appropriate record series.

Verification of calculations -- All compliance-related calculations performed in a database through queries will be reviewed for accuracy by a person other than the person who generated the query. This review will be documented and forwarded to the appropriate record series.

Software control -- The integrity of all databases will be ensured by maintaining them on a common server. This will enable the database administrator to control access to these databases, allowing only trained, authorized persons access to the databases.

Electronic media, continued

Spreadsheets

Backups -- All spreadsheets used to hold data and generate reports to be used in demonstrating compliance will be maintained in a secure location. The preferred location is on the group server. Spreadsheets will be backed up at least weekly.

Verification of data -- All compliance-related data uploaded into a spreadsheet will be verified to be accurate against the original paper copy. Data that are uploaded through electronic means will undergo 10% verification. Data that are uploaded through manual means will undergo 100% verification. The 100% review must be performed by someone other than the data entry person. This review will be documented and forwarded to the appropriate record series.

Verification of calculations -- All compliance-related calculations performed in a spreadsheet will be reviewed for accuracy by a person other than the person who generated the spreadsheet. This review will be documented and forwarded to the appropriate record series. Modifications to the function of these spreadsheets will also be verified in this manner.

Software control -- The integrity of spreadsheets will be ensured by limiting access to these spreadsheets to only trained, authorized personnel. Additionally, at least once per year, the function of the spreadsheets will be verified by hand calculations. Documentation of this review will be forwarded to the appropriate record series.

Section 5
Work Processes

Planning and Performing Work

Overview

LANL is required to comply with DOE Orders 5400.1 (DOE 1990a) and 5400.5 (DOE 1990b). The guidelines to be followed can be found in the Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE 1991c).

Purpose of contaminant monitoring work processes

The contaminant monitoring effort is used to gauge the quality of human health and the environment as influenced by Laboratory operations. The work processes described in this section are the methods that will be used to meet the quality assurance requirements for the monitoring of soil, foodstuffs, and biota for the purpose of determining concentrations, trends, and dose.

Data Objectives

Background

The project's data objectives are analyzed in this section using the EPA's data quality objective (DQO) process as a guide. The DQOs for the Soil, Foodstuffs, and Biota Monitoring Project were developed in accordance with EPA guidance (EPA 1994a).

DQOs are statements of the uncertainty level a decision maker is willing to accept in results derived from environmental data. As such, they comprise a management tool used to limit the chance of data leading to an incorrect conclusion. The DQO process must also define the required level of data defensibility and hence the level of documentation desired. DQOs must strike a balance between time, money, and data quality.

Problem statement

Based on past history and current activities, the project needs to measure radionuclides, heavy metals, and organic contaminants in the environment around LANL that may affect human health and the environment. LANL also wishes to quantify any impact from certain construction and waste management projects.

Data Objectives, continued

Decision

Principal questions: Do the radionuclides, heavy metals, or organic contaminants have a significant impact on the environment or increase the health risk to the public surrounding LANL?

Decision statement:

Are concentrations of radionuclides, heavy metals, or organic contaminants above actions levels or is there a significant upward trend in their concentrations? Action levels are determined for all sampling media (see subsection on determining action levels, page 19), and then actions are taken based on the EDE being within certain ranges (see "Decision rule and action levels," page 21, for the actual action levels). Trend analysis of all media is used to evaluate potential long-term accumulation trends and to estimate inventories of radionuclides, heavy metals, and organic contaminants.

Does the resulting analysis of annual public EDE from ingestion of terrestrial and aquatic foods and biota (DOE 1991c) containing these contaminant concentrations exceed the federal government standards limiting the dose that the public may receive?

When a similar analysis is performed for soils collected in several types of locations (onsite [within LANL boundaries], perimeter, and background, or control [over 15 km distant from the site]), are these standards exceeded?

If the answer to any of the above questions is "yes," LANL will make appropriate decisions (using soil, foodstuffs, and biota data), which could include

- identify the major contributor(s) and apply environmental As-Low-As-Reasonably-Achievable principles and emission controls to the source to reduce the major contributor(s);
- take corrective actions to reduce emissions;
- recommend evacuations or cleanups in response to unplanned releases;
- cease certain operations deemed to emit excessively;
- take other actions to modify emissions to achieve compliance with regulations.

Data Objectives, continued

Inputs to decision

Inputs to the decision require data on radionuclides, heavy metals, and organic contaminants in soil, foodstuffs, and biota that have a history of use at LANL that could have an impact on human health and on environmental quality. Exactly how this is accomplished is listed in the Environmental Monitoring Plan, as required by DOE (DOE 1991c).

The following radionuclides, heavy metals, and organic contaminants require monitoring under DOE requirements:

- ^{3}H, ^{234}U, ^{235}U, ^{238}U, ^{238}Pu, $^{239,240}Pu$, ^{241}Am, ^{90}Sr, ^{137}Cs, and total U;
- Ag, As, Ba, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, and Tl (and others); and
- volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), high explosives (HE), and/or organochlorine pesticides (OCPs).

The sample types will include

- soil surface material at the 0 to 2-inch depth
- foodstuffs:
  - produce
  - fish
  - honey
  - milk
  - eggs
  - game and nongame animals
- biota
  - vegetation
  - small and medium sized mammals
- foods (listed in approximate descending order of importance):
  - milk
  - vegetables
  - meat
  - eggs
  - grain
  - fruit
- wild game
  - deer
  - elk
  - game birds
- fish
  - bottom-feeding fish
  - predator fish

Data Objectives, continued

Determining action levels

Action levels will be determined as follows (see "Decision rule and action levels," page 21, for the actual action levels):

Under DOE requirements, action levels for each radionuclide, heavy metal, and organic contaminant will be set for each media at concentrations that represent a significant deviation from that media's historical concentration. Regional statistical reference levels (RSRLs, upper level background concentration at the 95%) will be determined as the mean plus two standard deviations from the last five years of data.

With respect to soils and radionuclides, action levels associated with larger concentrations of radionuclides, screening action levels (SALs), developed by the Environmental Restoration (ER) Project at the Laboratory (ER 2001), will be used. These concentrations correspond, for the contaminants of concern, to a 15-mrem/yr protective dose limit.

With respect to soils and action levels associated with relatively higher concentrations of heavy metals, SALs developed by the EPA for identifying the contaminants of concern based on health effects (EPA 2000) will be employed.

LANL currently uses multiple lines of evidence to manage biological resources that are potentially impacted by small levels of contamination occurring in environmental media within the Laboratory. Ecological risk assessment (Gonzales 2000) provides one line of evidence for making decisions on managing these resources: this information on potential impact to biota is relative and is best used to help focus field studies or additional assessments on the particular contaminants, geographical areas, or biological endpoints needing attention (Gonzales et al., 2001). The LANL ER Project (LANL 2002b) is in the process of reviewing the primary toxicity literature that toxicity reference values (TRVs) gathered from secondary sources (e.g., Oak Ridge National Laboratory) are based on. This review of the primary literature is being done in order to evaluate the appropriateness of the primary toxicity data for use as the TRV input to LANL's Ecological Screening Levels (ESLs). LANL will need to evaluate all of these questions relative to supporting a DOE Standard (DOE, 2002) in a future LPR.

Data Objectives, continued

Available analytical methods and detection limits

There are no DOE requirements for detection limits. In order to characterize any Laboratory impact, detection limits would ideally be set at or below environmental background levels. Although the analytical techniques are available, it is frequently not cost effective or technically feasible to request limits so low for all contaminants (the latter would be accomplished simply by analyzing a larger sample mass). Historically, the project has requested detection limits from the analytical laboratories as close to background concentrations as practically possible.

Study boundaries

This step defines and describes the statistical and spatial boundaries of the contaminant concentrations we wish to sample.

Sample population: The sample population is the concentration of each analyte in each media in the following regions:

- onsite (within the LANL boundary),
- perimeter (around the LANL boundary), and
- offsite (regional background or control location that is over 15 km distant from the site).

Spatial boundaries: The boundaries extend up to 80 km away from LANL. DOE requires an assessment of the dose to the Maximally Exposed Individual at the boundary and to the population up to 80 km away.

Population groups: The statistical population groups of interest are the concentrations in soil, foodstuffs, and biota in the following regions:

- on-site (within LANL boundaries)
- perimeter
- at a background or control location (over 15 km distant from the site)

Timeframe to which the decision applies: The data will be used to identify the dose to members of the public on an annual basis and the impact on the environment.

When to collect data: Soil will be collected after the snows have melted, foodstuffs will be collected during the fall months, and fish will be collected after the spring rains.

Data Objectives, continued

Scale of decision-making: Decision-making is limited to locations within 80 km of the Laboratory.

Practical constraints on data collection: Environmental concentrations of radionuclides, heavy metals, and organic contaminants are very low and thus the larger amount of sample that can be obtained, the better the detection levels that can be achieved.

Decision rule and action levels

This step describes the actions that will be taken when the measured concentration reaches certain levels to assess the Laboratory's impact on human health and the environment.

1). When assessing individual values, the result is checked to determine whether it is detectable or nondetectable. With respect to radionuclides, a detectable concentration is one where the final result is greater than the analytical counting error at the three-sigma level (99% confidence level). For heavy metals and organic constituents, a detectable value is one where it is higher than the minimum detection limit (reporting limit).

2). If the value is detectable, it is then compared to the upper limit regional background concentration (i.e., RSRL). The RSRL is the mean plus two standard deviations calculated from the last five years of data derived from regional locations. (RSRLs are published annually and are listed in the Environmental Surveillance Report [LANL 2001b]).

3). For soil, if the radionuclide or heavy metal result is a detectable value and exceeds the RSRL, the next question to be answered is whether or not the result exceeds the SAL. If this value is exceeded for heavy metals or radionuclides, a notification process is automatically executed (see Off-Normal Events subsection of RRES-ECO QMP [RRES-ECO 2002]).

4). For terrestrial foodstuffs and biota, three action level ranges relate to a range of values of the annual EDE (DOE 1991c):

- 0.1 and 1.0 mrem: Sufficient surveillance should be done to show that the radionuclides are behaving in the environment as expected;
- 1 and 5 mrem: Sufficient sampling and analysis should be carried out to provide reasonable assurance that the doses are within this range; and
- >5 mrem: Sufficient sampling and analysis should be carried out so that the foods and radionuclides contributing at least 90% of this ingestion dose have been evaluated.

5). For aquatic foodstuffs and biota, there are two radionuclide action level ranges:

- interim aquatic biota limit of 1 rad/day and
- the three action level ranges listed for terrestrial foodstuffs and biota.

6). To detect trends in concentrations with time, results in all media using detectable and nondetectable concentrations from the same site are compared statistically against

- regional background values at the 0.05 probability level and
- action level values described in items 3–5 above at the 0.05 probability level.

Data Objectives, continued

Precision

Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed conditions, expressed generally in terms of the standard deviation. It refers to the uncertainty that occurs if the same analysis was performed again on the same sample with no change in conditions, or the degree to which repeated measurements on the same sample agree. Results of repeated analyses of standard or duplicate samples provide an estimate of laboratory or instrument precision.

The regulation 40 CFR Part 61.93 (EPA 1994b) requires that the system be able to readily detect a dose of 1.0 mrem above background. Following statistical principles and assuming a confidence of 95% on such detection, 95% of all measurements must fall within two standard deviations of the mean measurement. If two standard deviations equal 1.0 mrem, then 1 standard deviation equals approximately 0.5 mrem. This represents the minimum acceptable precision for decision making.

However, to confidently detect environmental concentrations that are significantly less than 1.0 mrem, a smaller precision is needed. Therefore, the soil, foodstuffs, and biota project will use 0.1 mrem as the target precision for all measurements. Restated, measurement precision will be sufficient to distinguish a dose contribution from each radionuclide of 0.5 mrem (minimum) or 0.1 mrem (target minimum).

Data Objectives, continued

Accuracy

Accuracy is the degree of agreement of a measured value with the true or expected value of the quantity of concern. Biases of field sampling and sample preparation cannot be effectively estimated because the underlying, true mean values cannot be known for the population from which the samples are drawn without sampling the entire population. Estimated sample mean values are associated with intervals within which there is 95% confidence that the true mean lies. In the past, most estimated 95% confidence intervals have fallen between about +40% to +1100% of the estimated sample mean for produce and +20% to +6000% of the estimated mean for fish. Increased sample sizes would reduce the estimated confidence intervals, but even with this variability, the sample numbers are sufficient to detect differences corresponding to less than 1 mrem effective dose equivalent per year. Therefore, the additional samples appear unwarranted.

The accuracy of the concentrations of each measured radionuclide will be sufficient to distinguish a dose contribution from each radionuclide of 0.5 mrem (minimum) or 0.1 mrem (target minimum).

Any bias (known inaccuracy) will be corrected for if it is known or estimated. Unknown bias will be presumed to be zero because this is usually the best estimate.

Analytical accuracy is addressed in quality assurance documentation from the analytical laboratory. Where possible, replicates or blanks are submitted with samples for analysis at a rate of about one per 10 to 20 environmental samples.

Representation

Representation is a measure of the degree to which the data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Samples of foodstuffs are collected during periods when the public can be reasonably expected to collect these foods for consumption. Therefore, fish are collected during the summer months and produce and honey are collected during the fall. Thus, the samples are generally representative of what and when the public would consume it.

Data Objectives, continued

Comparability

Comparability is a measure of the confidence with which one data set can be compared to another.

Comparability of the sampler data is ensured because of the use of the same equipment, processes, and analytical methods at all sampler locations.

However, a number of factors influence sample results that are beyond the Laboratory's control. These include inherent variation of the sampled populations, variation in meteorological and hydrological dispersion characteristics, variation in growing conditions, variation in background levels, and variation in the availability of sampled populations. These factors operate in both spatial and temporal frameworks and affect the comparability of data from different locations and from different years. The procedures for sample collection, preparation, analysis, and interpretation are the same for each sample location per year and are the same as in previous years. Thus, comparisons of data from Los Alamos and vicinity can be drawn among locations and years with some reasonable but unquantifiable confidence. Direct comparisons of Los Alamos data with data from other DOE facilities is compounded by even greater differences among sampling and natural factors that affect estimated values for the food-chain pathway's contribution to exposure of the public and the environment.

Despite these factors, RRES-ECO will sample and analyze the soil, foodstuffs, and biota in the same manner each year to provide as much consistency as possible.

Data Objectives, continued

Completeness

Data may be lost due to instrument malfunction, power failure, sample destruction, human error, loss in shipping or analysis, analytical error, exceeding the hold time for the sample, failure to collect an adequate sample mass during the sampling period, inability to gain access to the site, or unacceptable precision or accuracy.

Completeness is a measure of the amount of valid data obtained compared to the amount expected under normal conditions. Completeness requirements for each of the following measurements have been identified:

Sample collection – The requirement for completeness of sample collection will be >90% for soil, foodstuffs, and biota. This includes all samples lost due to equipment malfunction, personnel error, and sample damage up to the point of delivery to the analytical laboratory. This measure will be evaluated at least annually.

Sample analysis – The requirement for completeness of sample analysis will be >90% for soil, foodstuffs, and biota. This includes all samples and data lost after delivery of samples to the analytical laboratory. This measure will be evaluated at least annually.

Sample Location and Design Rationale

Purpose	To collect representative annual samples that may be indicative of contaminant problems created by LANL and to be able to compare results historically.
Identification of sample types	Soil will include the soil surface material at the 0 to 2-inch depth. Foodstuffs include produce, fish, honey, milk, eggs, and game and nongame animals. Biota includes vegetation, and small and medium sized mammals.
Rationale	Sampling locations have been chosen to demonstrate the presence, if any, of radionuclides, heavy metals, and organic contaminants in the food chain as a result of Laboratory operations. Onsite sampling locations are situated in areas expected to receive releases from the Laboratory's operations. Local perimeter locations are situated where radionuclides, heavy metals, or organic contaminants are expected to be carried under most meteorological and hydrological conditions. Regional locations are situated in areas expected to have little or no effects from Laboratory operations because of distance and normal meteorological and hydrological conditions. Given the constraints on measuring background at a potentially affected site, variability of background with time and space, natural variability among biological systems, and the variability of the public's eating habits; we believe the sample locations are as valid and representative as reasonably achievable. Soil provides an integrating medium that can account for contaminants released to the atmosphere, either directly in gaseous effluents (such as air stack emissions) or indirectly from re-suspension of onsite contamination (such as firing sites and waste disposal areas). This can also happen through liquid effluents released to a stream that is subsequently used for irrigation. Therefore, the knowledge gained from a soil radiological sampling program is critical for providing information about potential pathways (such as soil ingestion, food crops, re-suspension into the air, and contamination of groundwater) that may result in a radiation dose to a person (Fresquez et al., 1998). Our current emphasis is on organic chemical analysis, because research has determined that the highest risk to nonhuman biota at the Laboratory is from organic compounds such as pesticides and PCBs (Gonzales 2000).
Soil	Soil provides the most direct means of determining the concentration (activity), inventory, and distribution of radionuclides and radioactivity around nuclear facilities.

Sample Location and Sample Design Rationale, continued

Foodstuffs

A variety of wild and domestic edible plant, fruit, and animal products are grown or harvested in the area surrounding the Laboratory. Ingestion of foodstuffs constitutes a critical pathway by which radionuclides, heavy metals, and organic contaminants can be transferred to humans. The principal pathways by which foods become contaminated are deposition from airborne material and crop irrigation from surface waters.

Biota

Biota (nonfoodstuffs), such as small mammals, amphibians, birds, and vegetation, are monitored within and around LANL on a systematic or special study basis for the protection of ecosystems (DOE 1991c). Some human foodstuffs are also monitored that serve as an important link in ecological food chains, such as fish consumed by bald eagles.

Sample Collection

Purpose

To define what types of representative samples to collect, as well as when and where to collect samples that may be indicative of any contamination problems created by LANL. The committed effective dose equivalent (CEDE) is then calculated from the results of the radiochemical analyses of these samples (this calculation is performed by another organization and is not covered by this QAPP).

Soil

Soil will include the topsoil at a depth of 0 to 5 cm (0 to 2 inches). The soil surveillance program at LANL consists of an institutional program that monitors soil contaminants within and around LANL and a facility program that monitors soil contaminants directly around the perimeter of major facilities at LANL. The main objectives of these projects include evaluating

- radionuclide, heavy metal, and organic contaminant concentrations in soil collected from potentially impacted areas (institution- and facility-wide);
- trends over time (that is, whether radionuclides, heavy metals, and organic contaminants are increasing or decreasing over time); and
- CEDE to surrounding area residents.

Produce

Produce, for purposes of the foodstuffs monitoring project, is defined as any fruit, vegetable, and/or grain that could be consumed directly from a garden or an orchard after simple washing. Produce will be collected every year starting from late summer to early fall from onsite, perimeter, and regional background locations, as available. The types of produce collected may include garden-variety squash, cucumbers, chile, sweet corn, lettuce, melons, pumpkins, tomatoes, peaches, apricots, plums, and apples.

Fish

Fish samples are collected between May and September of every year from Abiquiu Reservoir (upstream of LANL) and Cochiti Lake (downstream of LANL). The fish collected will include at least three species of bottom-level feeders (nongame or bottom-feeding fish) and at least three species of higher-level feeders (game or predator fish). Nongame fish should include channel catfish (*Ictalurus* spp.), suckers (*Catosponus* spp.), and carp (*Cyprenus* spp.). Game fish should include white crappie (*Pomoxis annularis*), trout (*Salmo* spp.), salmon (*Oncorhyncus* spp.), bass (*Micropterus* spp.), and walleye (*Spizostedion vitreum*).

Sample Collection, continued

Honey	Honey will be collected in the fall of every second or third year from perimeter and background locations.
Milk	Milk will be collected in the summer of every second or third year from the closest milk-producing animal; in recent years this has been from goats in the Los Alamos and White Rock areas.
Game animals	Game animals such as elk and deer will be collected; the frequency of these studies will be based on samples collected from (fresh) road kills.
Eggs	Fresh eggs will be collected from free-ranging chickens from the Los Alamos and White Rock town site areas and from the Pueblo of San Ildefonso every second or third years.
Domestic animals	Cattle owned by residents of the Pueblo of San Ildefonso graze the boundaries of LANL on a regular basis and are offered by the Pueblo for sampling and analysis; however, the donation of meat is very infrequent.
Piñon	Piñon nut and tree shoot tips will be collected from three perimeter areas surrounding the Laboratory: Los Alamos on the north, White Rock on the southeast, and Pueblo of San Ildefonso lands on the east as a special study project.
Herbs and tea	Navajo tea (Cota) will be collected from three perimeter areas surrounding the Laboratory: Los Alamos town site on the north, White Rock on the southeast, and Pueblo of San Ildefonso lands on the east as a special study project.
Vegetation	Unwashed overstory and understory vegetation from 25 locations (onsite, perimeter, and offsite soil sampling stations) are collected every third year.
Small and medium sized mammals	Small mammals like rodents and medium sized mammals like raccoons, lions, and coyotes are collected on an infrequent basis.

Sample Locations

Purpose

To define where soils, foodstuffs, and biota samples are collected.

Soil monitoring

Monitoring stations are located within 12 onsite (Laboratory lands), 10 perimeter, and three regional (background) locations. Onsite stations are within the Laboratory boundary, and most are in areas accessible only to employees during normal working hours. Perimeter stations are within 4 km (2.5 miles) of the Laboratory boundary and many are within residential and community areas. Individual soil monitoring stations within these areas (onsite and perimeter) were located to intercept any contamination related to Laboratory operations; stations, therefore, were mostly located downwind from the major potential contaminant sources. Both of these areas will be compared to radionuclides (and heavy metals) in soils collected from background regional stations.

Background regional stations are located within the three counties surrounding Los Alamos County at distances up to 80 km (50 mi) from the Laboratory; specifically, the regional stations are located near Embudo, Cochiti, and Jemez. These areas have been sampled since 1974 (Purtymun 1987); and the average concentrations plus twice the standard deviation from 1994 to 1997 (Fresquez et al. 1998) were used to establish the upper-limit background concentration of radionuclides in soils. Locations of all soil stations are found in Table 3 and Figure 1.

Foodstuffs and biota monitoring

Foodstuffs and biota samples will be routinely collected annually for the Environmental Surveillance Program at three locations: (1) onsite, (2) perimeter, and (3) regional. Regional background locations will be mostly sampled upstream from the confluence of the Rio Grande and intermittent streams that cross Laboratory lands. They will also be sufficiently distant from the Laboratory as to be unaffected by airborne emissions.

Table 4, Table 5, and Figure 2 summarize the locations for the sampling and analysis of foodstuffs and biota.

Table 3. Soil Surveillance Project Locations

Note: All stations listed below are sampled annually.

Station Name
Regional (Background) Stations
Embudo
Cochiti
Jemez
Bandelier (Cerro Grande)
Perimeter Stations
Los Alamos Sportsman's Club
North Mesa
Technical Area (TA) 8 (GT Site)
Near TA-49 (Bandelier National
White Rock (East)
Tsankawi/PM-1
Otowi
East Airport
West Airport
San Ildefonso
Onsite Stations
TA-21 (DP Site)
East of TA-53
West of TA-53
TA-50
TA-51
Two-Mile Mesa
East of TA-54
R-Site Road East
Potrillo Drive/TA-36
TA-16 (S-Site)
Near Test Well DT-9
Near TA-33

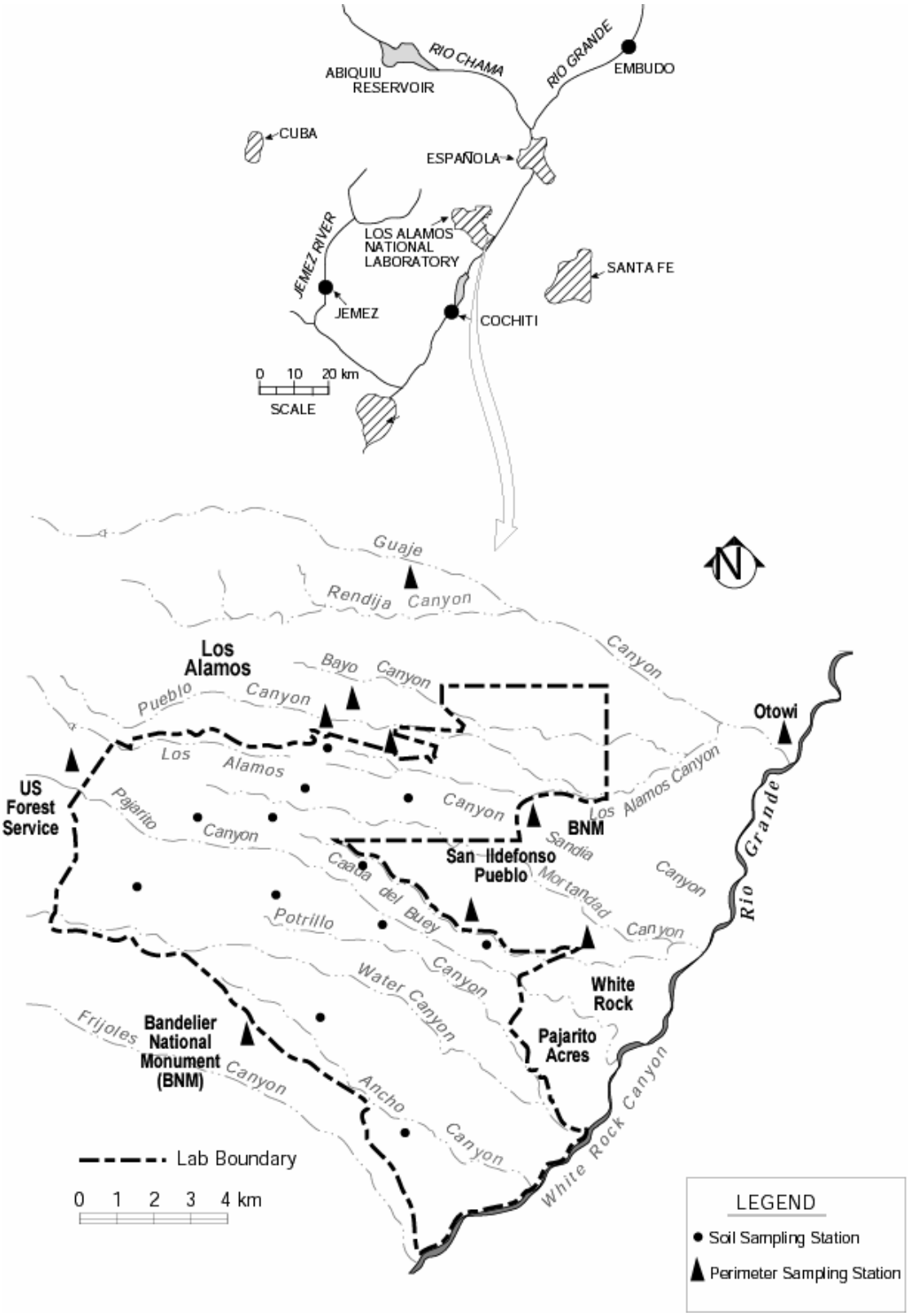

Figure 1. Offsite regional (top) and perimeter and onsite (bottom) Laboratory soil sampling locations.

Sample Location, continued

Table 4. Sampling Locations for Analysis of Foodstuffs.

Matrix	No. Regional (approx.)	No. Perimeter (approx.)	No. On-Site (approx.)	Sampling Frequency
Produce	1	3	1	Annual
Fish	1	1	0	Annual
Honey	1	3	0	Infrequent
Milk	1	2	0	Infrequent
Eggs	1	2	0	Infrequent
Game Animals	1	0	1	Annual
Herbs	1	3	0	Seasonal
Piñon	1	3	0	Seasonal
Domestic Animals	1	1	0	Infrequent

Table 5. Sampling Media by Locations.

Location	Matrix	Sampling Frequency
Regional Stations		
Española (San Pedro)	Honey	Infrequent
Española/Santa Fe/Jemez	Produce Eggs Piñon, Herbs	Annual Infrequent Seasonal
Abiquiu	Fish: Surface Feeders Bottom Feeders	Annual Annual Annual
Albuquerque	Milk	Infrequent
Perimeter Stations		
Los Alamos	Produce Eggs Piñon, Herbs Milk Honey	Annual Infrequent Seasonal Infrequent Infrequent
White Rock/Pajarito Acres	Produce Eggs Piñon, Herbs Milk Honey	Annual Infrequent Seasonal Infrequent Infrequent
Cochiti	Fish: Surface Feeders Bottom Feeders	Annual Annual Annual
Cochiti/Santo Domingo/Peña Blanca	Produce	Annual
San Ildefonso	Produce Eggs Piñon, Herbs Domestic Animals	Annual Infrequent Seasonal Infrequent
Onsite Stations		
LANL-Wide	Game Animals, Produce	Annual

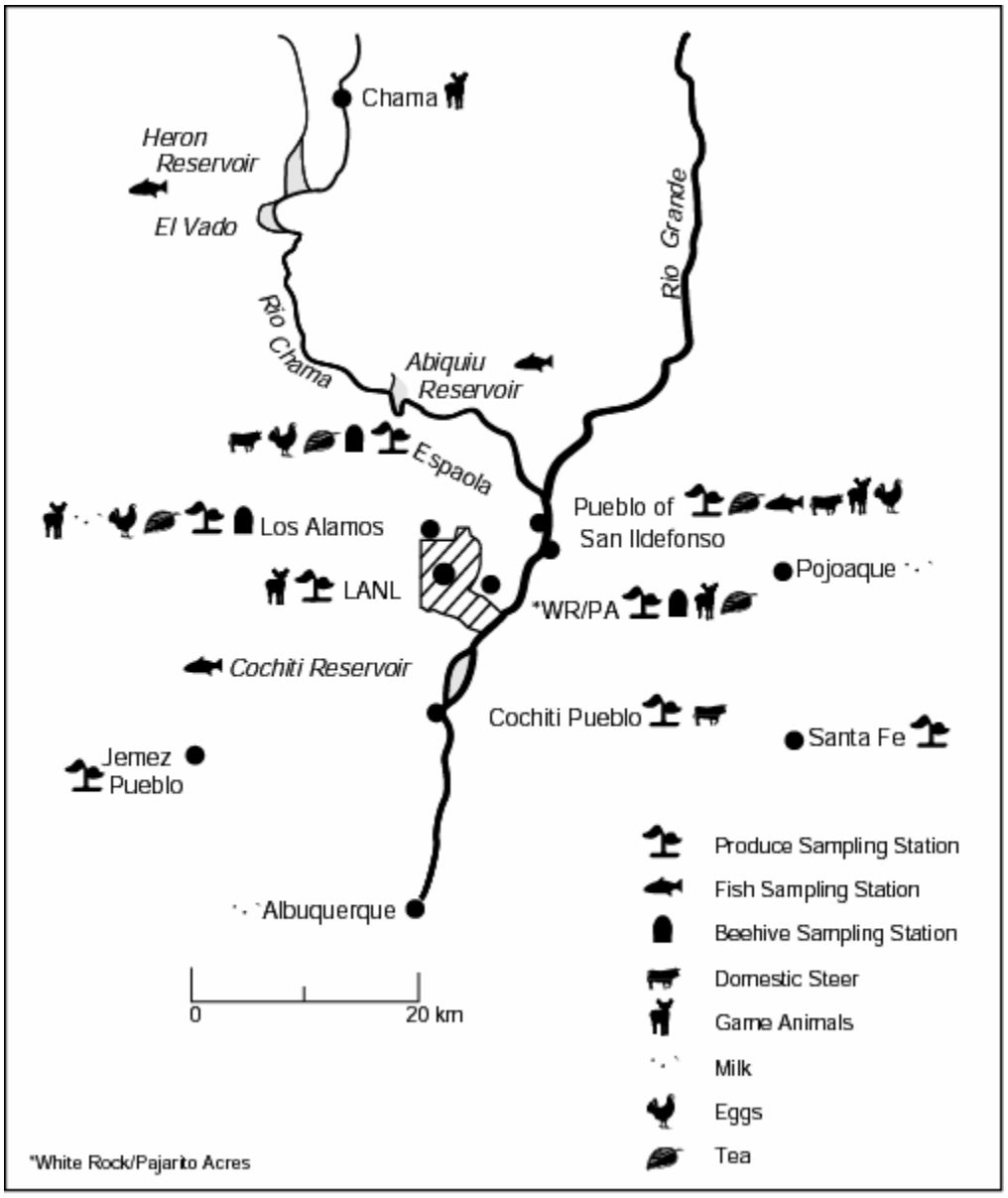

Figure 2. Produce, fish, milk, eggs, tea, domestic and game animals, and beehive sampling locations.

Sample Analysis

Purpose

All sample types will be quantitatively analyzed for the presence of selected radionuclides, heavy metals, and organic constituents.

Sample preparation

RRES-ECO will prepare samples for shipping to an offsite laboratory. Normally, soil is shipped directly to the analytical laboratory; whereas, water is first distilled from fresh foodstuff and biota samples (for tritium analysis) before the sample being ashed. Foodstuffs and biota samples are ashed to concentrate radionuclides. For organic and heavy metal analysis in fish, the sample is sent on a fresh-weight basis. The entire sample will be shipped to the analytical laboratory.

Constituents of interest

Soil samples are usually analyzed for the following:

- ^{3}H, ^{234}U, ^{235}U, ^{238}U, ^{238}Pu, $^{239,240}Pu$, ^{241}Am, ^{90}Sr, ^{137}Cs, and total U;
- Ag, As, Ba, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, and Tl (and others); and
- VOC, SVOC, PAHs, PCBs, HE, and/or OCP.

Foodstuffs and biota are usually analyzed for the following:

- ^{3}H, ^{234}U, ^{235}U, ^{238}U, ^{238}Pu, $^{239,240}Pu$, ^{241}Am, ^{90}Sr, ^{137}Cs, and total U and
- Ag, As, Ba, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, and Tl (and others).

Fish are usually analyzed for the following:

- ^{3}H, ^{234}U, ^{235}U, ^{238}U, ^{238}Pu, $^{239,240}Pu$, ^{241}Am, ^{90}Sr, ^{137}Cs, and total U;
- Ag, As, Ba, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, and Tl (and others); and
- PAHs, PCBs, HE, and/or OCP.

Frequency of analysis

Soil, produce, and fish are sampled and analyzed on an annual basis. All others are sampled on an infrequent basis or every second or third year. The results of the analyses will be available within 45 days of sample submittal.

Calibration of analytical equipment

Analytical equipment will be maintained and calibrated by the analytical laboratory. The frequency of these activities and the supporting documentation will be maintained and will be made available for audit and inspection.

Sample Analysis, continued

Detection limits

There are no DOE requirements for detection limits. In order to characterize any Laboratory impact, detection limits would ideally be set at or below environmental background levels. However, it is frequently not cost effective or technically feasible to request limits so low for all contaminants. Historically, the project has requested detection limits from the analytical laboratories as close to background concentrations as practically possible.

Sample Tracking

Purpose	The soil, foodstuffs, and biota samples are used to demonstrate compliance with DOE requirements. The RRES-ECO policy of control of samples is addressed in the Group's QMP (RRES-ECO 2002), which explains that environmental samples will be controlled to maintain legally defensible data and to prevent cross contamination or data loss. Any persons involved in the preparation, retrieval, and analysis must maintain positive control of samples at all times until sample disposal.
Chain-of-custody during sample preparation and retrieval	Positive control of samples maintained during sample preparation and retrieval according to the chain-of-custody requirements. All persons (other than analytical personnel) performing sample preparation and collection will be trained to sample collection procedures and must adhere to the chain-of-custody requirements therein. Identification and documentation of each sample will be established and maintained to assure that each sample is traceable and identifiable. Chain-of-custody requirements can be found in the RRES-ECO QMP (RRES-ECO 2002).
Chain-of-custody during analysis	Any analytical laboratory that is contracted to perform sample analysis on samples will maintain sufficient procedures to ensure positive control of samples.
Chain-of-custody during storage/ disposal	Retained samples or sample portions will be maintained under chain-of-custody by the analytical laboratory until reanalysis, return to RRES-ECO, or ultimate disposal.

Dose Calculations

Purpose The purpose of collecting soil, foodstuffs, and biota is to estimate the radiological dose to humans (and biota) from the ingestion, inhalation, and direct contact of these media. Dose is calculated to demonstrate compliance with the limits of DOE Orders; namely the limit is 100 mrem.

Requirement RRES-ECO provides the data from soil, foodstuffs, and biota to the Meteorology and Air Quality Group to calculate dose.

Process Verification and Peer Review

Purpose

Work activities related to measuring radionuclide, heavy metals and organic contaminants in soil, foodstuffs, and biota will be reviewed and verified by qualified persons to ensure that project requirements are met.

Verification and peer review methods

Through a process of peer review and verification, LANL helps ensure that these activities meet project requirements. These methods are described below for each process.

Process	Method(s)
Data Quality Objectives	Representatives from RRES-ECO will approve the initial DQOs and will approve any modifications to these DQOs. At least once per year, RRES-ECO will determine adherence to the DQOs. Failure to meet any of the DQOs will be addressed as deficiencies.
Sample collection	Before the collection of new samples, review all sample locations used to monitor soil, foodstuffs, and biota. Periodically review the collection schedule of the differing media to ensure the frequency continues to be acceptable.
Sample analysis	As data are received, verify data are complete, reasonable, and meet the requirements of this QAPP and any applicable Statements of Work.
Sample tracking	At least once during the year, review chain-of-custody documentation for sample collection personnel and analytical laboratories. This may be accomplished through routine audits and assessments.

Section 6
Program Design Activity

This project requires no hardware design activity.

Section 7
Procurement of Items and Services

Procurement of items and services

The Soil, Foodstuffs, and Biota Monitoring Project will procure services from qualified persons and/or organizations as needed to accomplish project goals. Procurement of items and services used in the Soil, Foodstuffs, and Biota Monitoring Project will follow the Laboratory procurement process and the requirements in the RRES-ECO QMP (RRES-ECO 2002).

Most items and services required for the project are commercial grade in nature and no special procurement requirements or needs are necessary. For items and all services for which special requirements are necessary, the Project Leader and project members will identify such items or services. Such items and services include analytical services.

Section 8
Inspection and Acceptance Testing

Policy

Any materials or services will be inspected and/or tested before acceptance for use in monitoring. Most supplies used during performance of monitoring are commercial grade in nature and require no special acceptance practices or procedures. Inspection and acceptance of analytical deliverables is addressed in Section 5.

Section 9
Management Assessment

Project Management Assessments

Internal assessments

RRES-ECO conducts internal management assessments of all projects and programs in the group in accordance with requirements in the RRES-ECO QMP (RRES-ECO 2002).

The Group Leader will perform an assessment of the effectiveness of the project effort periodically. Assessments of the project are documented and filed as records.

Responding to assessments

When violations of requirements are found during a management assessment, a deficiency report is initiated to document the violation. Corrective actions are tracked and documented in accordance with RRES-ECO-026, "Deficiency Reporting and Correcting" (To Be Written).

Section 10
Independent Assessments

Project Assessments

Policy

The Soil, Foodstuffs, and Biota Monitoring Project will undergo audits and assessments by persons not responsible for the performance of the work.

Internal audits

The RRES-ECO QMP (RRES-ECO 2002) stipulates that independent assessments (audits) will be conducted throughout the group, as specified by the group leader, to verify compliance with all project requirements and all aspects of the group QMP (see Section 10 of RRES-ECO 2002).

Annual audits/assessments will be conducted by the Group Leader, with input from the Project Leader, and will identify one or more areas of the project to be audited each year by October 15.

Periodic performance audits of the measurement component of the project are conducted by a qualified contractor. Formal reports are shelved at TA-21-210-133A.

Implementation

The following table lists specific responsibilities.

Who	What
Soil, Foodstuffs, and Biota Monitoring Project Leader	Approves audit schedules. Provides input to RRES-ECO Quality Assurance Officer (Position To Be Created) as to the content of internal audits. Review audit reports for factual accuracy. Address all findings and implement corrective actions as appropriate.
Quality Assurance Officer (Position To Be Created)	Identify areas to be addressed during internal audits. Contract with the Quality Management Group to perform annual internal audits. Review audit procedures to ensure they meet the requirements in this section.

Team members	Cooperate with auditors by providing information, data, etc. Implement corrective actions as directed by Project Leader.

Assessing Suppliers

Policy

The Project Leaders (in coordination with the Group Quality Assurance officer) will ensure that periodic assessments are conducted to determine whether required information from the following organizations meets quality specifications:

- analytical laboratories supplying data and
- organizations supplying services (such as Johnson Controls Northern New Mexico).

If problems are found with a supplier's product, RRES-ECO will work with that supplier until the problem is corrected or will obtain alternate suppliers.

Analytical laboratories

RRES-ECO will perform annual audits of analytical laboratories that provide analytical data used in compliance calculations. These audits will be conducted by the RRES-ECO Analytical Chemistry Coordinator (Position To Be Created) in conjunction with the RRES-ECO Quality Assurance Officer (Position To Be Created) and/or any other persons the coordinator deems appropriate.

Appendix A
References, RRES-ECO Procedure Documents and Personnel Positions To Be Created

References

DOE 1989: US Department of Energy, "Comprehensive Environmental Response, Compensation, and Liability Act Program," DOE Order 5400.4 (October).

DOE 1990a: US Department of Energy, "General Environmental Protection Program," DOE Order 5400.1 (June).

DOE 1990b: US Department of Energy, "Radiation Protection of the Public and the Environment," DOE Order 5400.5 (June).

DOE 1991a: US Department of Energy, "Quality Assurance," DOE Order 5700.6C (August).

DOE 1991b: US Department of Energy, "Quality Assurance," 10 CFR 834.120 (August).

DOE 1991c: US Department of Energy, "Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance," DOE report DOE/EH-0173T (January).

DOE 1992: US Department of Energy, "Fire Protection," DOE Order 5480.7A (December).

DOE 1995a: US Department of Energy, "Comprehensive Emergency Management System," DOE Order 151.1 (September).

DOE 1995b: US Department of Energy, "Environment, Safety, and Health Reporting," DOE Order 231.1 (September).

DOE 1996: US Department of Energy, "Land and Facility Use Planning," DOE Policy DOE P 430.1 (July).

DOE 1998: US Department of Energy, "Quality Assurance," DOE Order 414.1A (July 2001).

DOE 2001: US Department of Energy, "Greening the Government through Leadership in Environmental Management," DOE Notice DOE N450.5 (Extends N450.4) (February).

DOE 2002: US Department of Energy, "a Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota," DOE Standard DOE-STD-1153-2002 (July).

EPA 1994a: US Environmental Protection Agency, "Guidance for the Data Quality Objectives Process," EPA report EPA QA/G-4 (September).

EPA 1994b: US Environmental Protection Agency, "National Emission Standards for Emissions of Radionuclides other than Radon from Department of Energy Facilities," Code of Federal Regulations, Title 40, Part 61 (1994).

EPA 2000: US Environmental Protection Agency, "Human Health Medium Specific Screening Levels," Region 6, Multimedia Planning and Permitting Division, www.epa.gov//region6/6pd/rcra6/pd7/screen.htm.

ER 2001: ER, "Derivation and Use of Radionuclide Screening Action Levels," Los Alamos National Laboratory report LA-UR-01-990.

Fresquez et al., 1998: P. R. Fresquez, D. R. Armstrong, and M. A. Mullen, "Radionuclides and Radioactivity in Soils Collected From Within and Around Los Alamos National Laboratory: 1974–1996," *Journal of Environmental Science and Health* A33 (2) 263–278.

Gonzales 2000: G. J. Gonzales, "White Paper: Biocontaminant Monitoring Issues at the Los Alamos National Laboratory," Los Alamos National Laboratory document LA-UR-00-0196.

Gonzales et al., 2001: G. Gonzales, A. Gallegos, P. Newell, R. Ryti, K. Bennett, J. Biggs, S. Koch, M. Mullen, O. Myers, L. Soholt, R. Vocke, and W. J. Wenzel, "Tier 2 Ecological Risk Assessment of Los Alamos National Laboratory Institutional Issues on the Pajarito Plateau Using ECORSK.6," Los Alamos National Laboratory document LA-UR-01-1034.

LANL 2001a: Los Alamos National Laboratory, "Appendix F – Objective Standards of Performance," Modification No. M537, Supplemental Agreement to Contract No. W-7405-ENG-36 (October).

LANL 2001b: Los Alamos National Laboratory, "Environmental Surveillance at Los Alamos during 2000," Los Alamos National Laboratory report LA-13861-ENV (October).

LANL 2002a: Los Alamos National Laboratory Performance Requirement, "Environmental Protection: Managing Waste; Air Quality; Ecological and Cultural Resources; Waste Minimization and Pollution Prevention; and Surface and Groundwater," Laboratory Performance Requirement 404-00-00.2 (June).

LANL 2002b: Los Alamos National Laboratory, "ECORISK Database (Release 1.4)," Environmental Restoration Project package number 186.

Purtymun 1987: Purtymun, W.D., "Background Concentrations of Radionuclides in Soils and River Sediments in Northern New Mexico, 1974–1986," Los Alamos National Laboratory report LA-11134-MS (November).

RRES-ECO 2002: RRES-ECO Quality Management Plan (QMP).

Stavert 2002: Stavert, D., "Integrated Management Plan for the Environmental Protection Programs," RRES Division controlled document (July).

Manuscripts To Be Written

RRES Division Quality Management Plan

RRES-ECO-030, "Document Distribution"

RRES-ECO-024, "Personnel Training

RRES-ECO-026, "Deficiency Tracking and Reporting."

Positions To Be Created

RRES-ECO Analytical Chemistry Coordinator

RRES-ECO QA officer